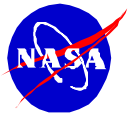
SPACE SHUTTLE PROGRAM
Space Shuttle Program Integration
NASA Johnson Space Center, Houston, Texas



STS-112 Flight Readiness Review

September 17, 2002

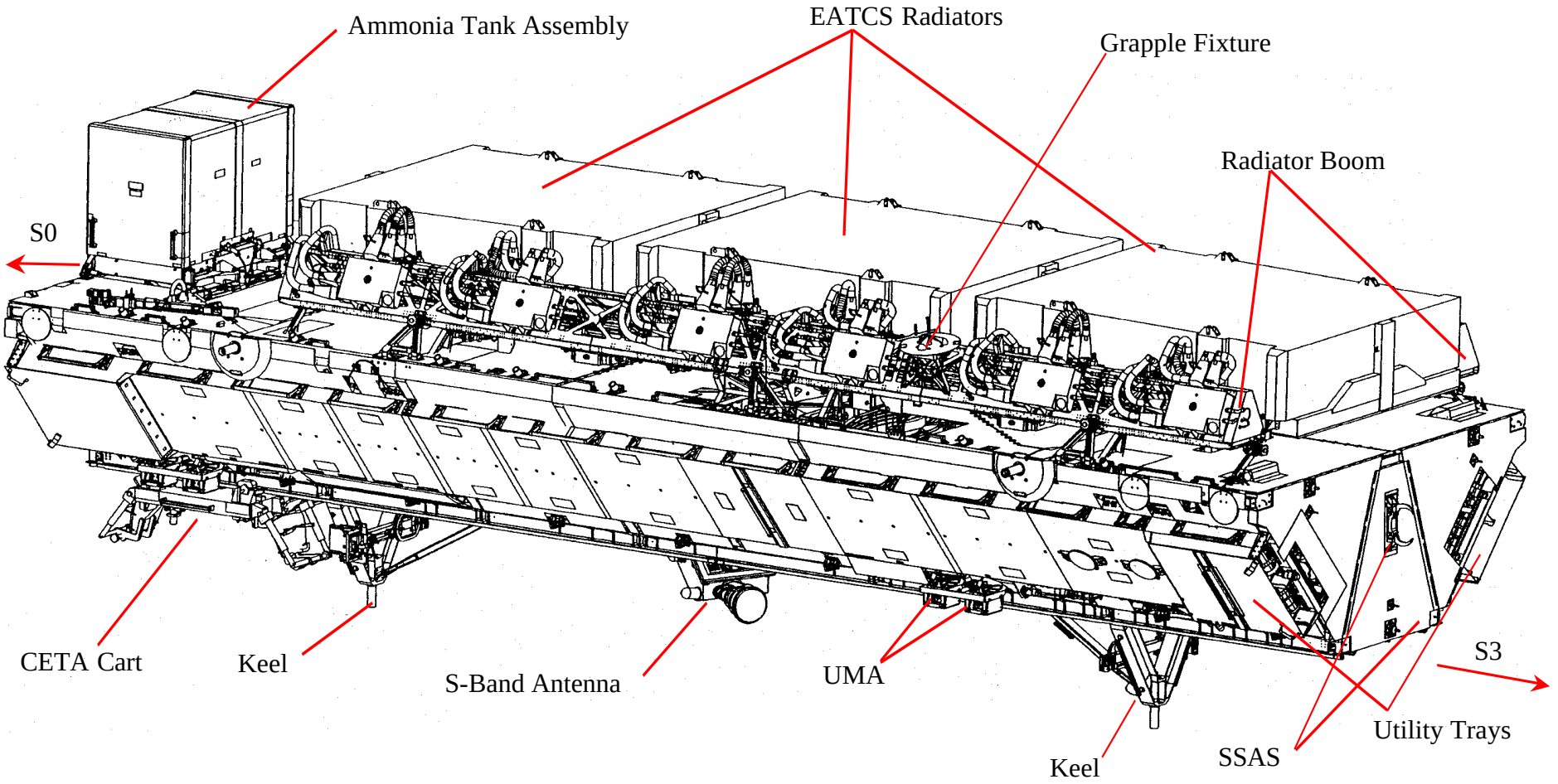
Agenda

• Program Integration - Flight Manager *	Robert Galvez
• Key Program Considerations	
• Payload & System Safety	
• Orbital Debris Status *	No Issues
• Payload In-Flight Anomalies	No Issues
• Launch Commit Criteria *	No Issues
• Program Integration*	Bob White
• Waivers to Vol X	No Issues
• System Integration TMR	Lambert Austin
• Flight Readiness Statement	

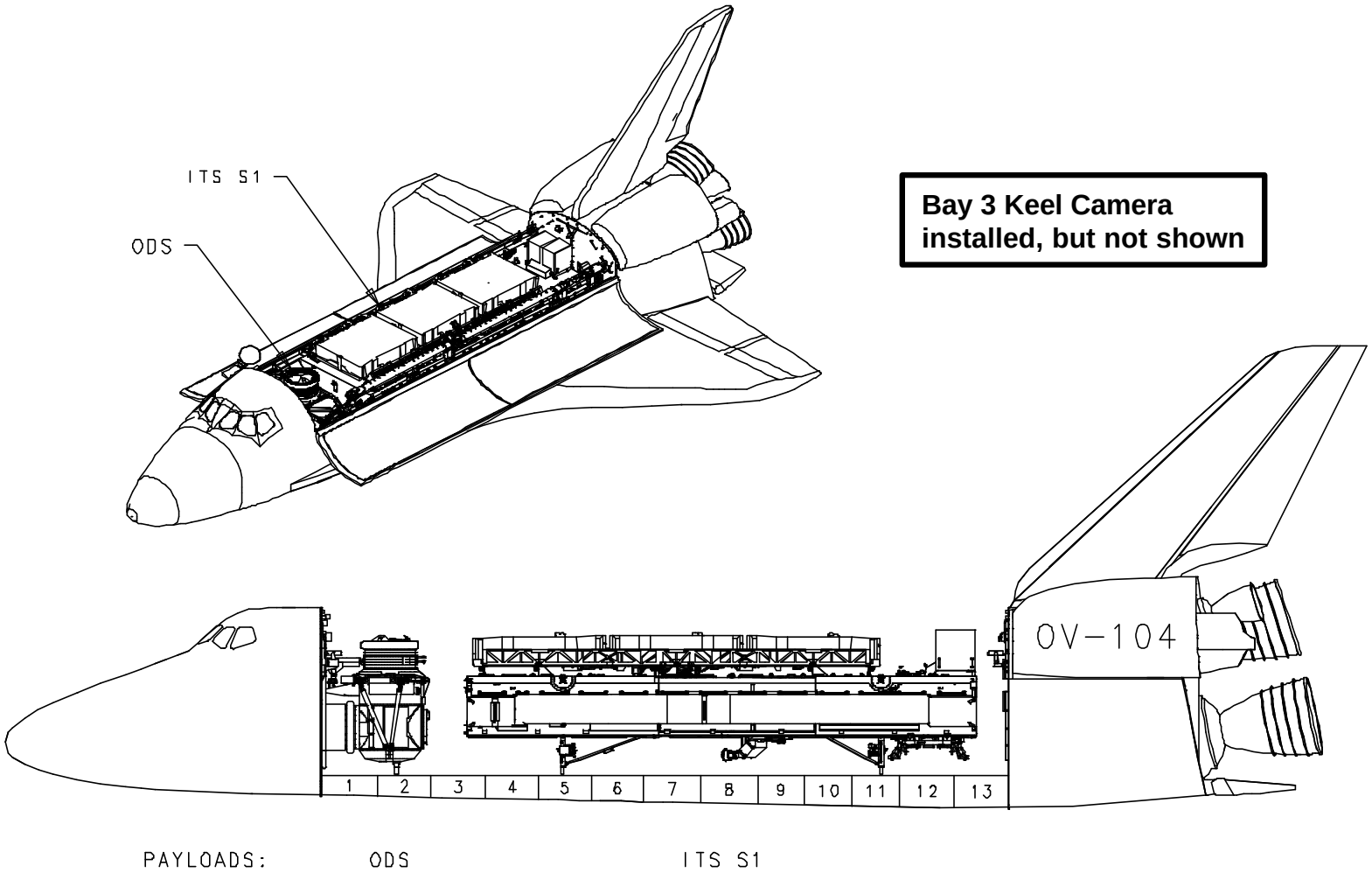
* Backup Material Included

On-Orbit Configuration

Presenter Robert Galvez



Cargo Bay Arrangement



Bay 3 Keel Camera installed, but not shown

PAYLOADS: ODS ITS S1

Key Program Considerations

- **Mission Duration (11+1+2) / 72 Pad Hold Capability**
  - **DI 122 supports FD3 Rendezvous**
  - **Three scheduled EVA within 11 day mission**
  - **7 docked days to ISS**
  - **Launch capability through 10/19/02 due to spacing constraints with Soyuz launch on 10/28/02**
  - **15th Shuttle flight to the ISS**
- **Middeck Stowage**
  - **There is no remaining volume after accounting for all ISSP H/W requirements**
    - **Several PRCB CRs processed within last month due to changes in ISSP requirements (e.g., TVIS, Cryodewar, EMU Batteries, PGTs, etc.)**
    - **Except for TVIS, all H/W supports L-10 day Bench Review on 9/20. TVIS inspection to be done by the crew once installed in middeck. ECD: 9/25/02**
  - **Descent Manifest has been finalized.**
    - **There is no remaining volume for real-time changes. Changes will require deletion of current content.**
- **Robotics Operations**
  - **SSRMS will perform all S1 berthing and EVA support operations**
    - **SRMS used for orthogonal views during S1/S0 berthing operations.**

Middeck Payloads

- Ascent Powered
  - Commercial Generic Bioprocessing Apparatus (CGBA)
  - Plant Generic Bioprocessing Apparatus (PGBA)
  - Protein Crystal Growth – Single Locker Thermal Enclosure Systems (PCG-STES)
- Ascent Un-powered
  - Cellular Biotechnology Operating Science System (CBOSS) Cryodewars
  - Human Research Facility (HRF) – Puff Data Kit
  - HRF – Urine Collection Kit
  - Zeolite Crystal Growth – Sample Stowage (ZCG-SS)
- Return Powered
  - PCG-STES
- Return Un-powered
  - Advanced Astroculture-Growth Chamber (ADVASC), and Samples
  - Zeolite Crystal Growth-sample storage
  - HRF Increment 4 sample/data
  - Microencapsulation Electrostatic Processing (MEPS)
  - CBOSS Cryodewars and CGBA samples
  - Space Acceleration Measurement System (SAMS) Hard drive and Laptop battery
- Secondary Payloads
  - Spatial Heterodyne Imager for Mesospheric Radicals (SHIMMER), Sponsor: DOD
  - Ram Burn Observation (RAMBO), Sponsor: DOD

Payload and System Safety

- Integrated Hazard Assessment is complete
- Toxicology Process
  - Verification 1: Complete
  - Verification 2: Standard open work for late load items
- Payload Safety Review Process
  - No issues

Integration Issues

- TVIS Middeck Stowage Certification
  - Orbiter analysis verified positive margin to increase weight of 125 lbs.
    - VECB approved waiver 9/13/02

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ET-Mounted Shuttle Observation Camera

STS-112 FRR

October 2, 2002

JSC/MS/L. D. Austin

Agenda

- Demo Video
- Camera Overview and Verification
  - Systems Integration/Lambert Austin
- Flight Hardware
  - ET Project/Neil Otte
- Ground Systems
  - KSC/Mike Madden
- Network Configuration / Modifications
  - GSFC/Ted Sobchak

Special Topic – ET Observation Camera Mission Specific Certification

- ET Camera implementation on STS-112 approved at 12/01 PRCB
- The following System Integration functions verified acceptable certification for the ET camera system
  - Aeroheating and protuberance airload environments were defined for camera fairing regions and the 2 S-band antennas
  - Debris assessments were performed to evaluate the hazard associated with camera on LO2 tank
    - No orbiter window impacts predicted
    - Potential wing leading edge & lower wing impacts but determined not to be a flight safety issue

Camera Verification

- Safety Assessment Report (SAR) approved at March 9 2000 SSRP
  - No update to Integrated Hazards required
- MSFC independent assessment performed and ET response to findings completed June 2000
  - Required testing successfully completed 11/00
- Frequency Approved June 2000 by JSC Frequency Manager
  - 2272.5 MHz for 5 years – can be extended if required
- KSC facilities modifications completed
- Verification Testing
  - Network Test - June 2002
  - Integrated flight & ground hardware tests – September 10th and 18th, 2002

System Summary

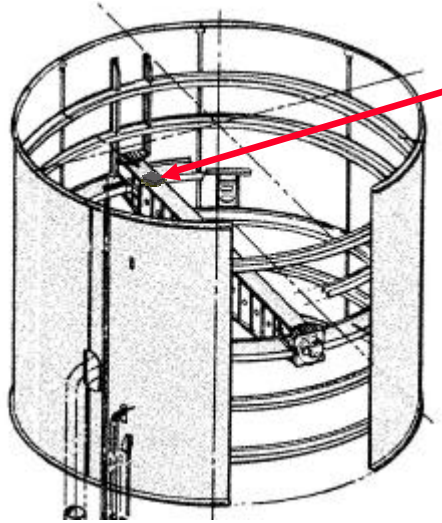
- Camera system implemented at KSC by mod kit
  - Installed and functionally tested in ET checkout cell in the VAB
- System operated from firing room during launch operations
  - Battery charging completed prior T-11 hr hold
  - System activated at L-15 minutes
  - Turns off at L+15 min
- System to provide live coverage
  - L-15 min to MET 15 min
- Video will be transmitted to MILA for airing through PAO real-time

ET Camera Hardware Design

- Design Philosophy
  - Groundrules were developed to allow safe implementation and quick turnaround
    - Safety was identified as the highest priority in system design
      - System was designed to function independently of all other Shuttle systems
      - Factor of safety of 3 2.0 required for all camera system flight hardware
    - Commercial Off the Shelf (COTS) hardware preferred to reduce system development time
    - Implementation on ET is by Mod Kit to allow quick turnaround on installation

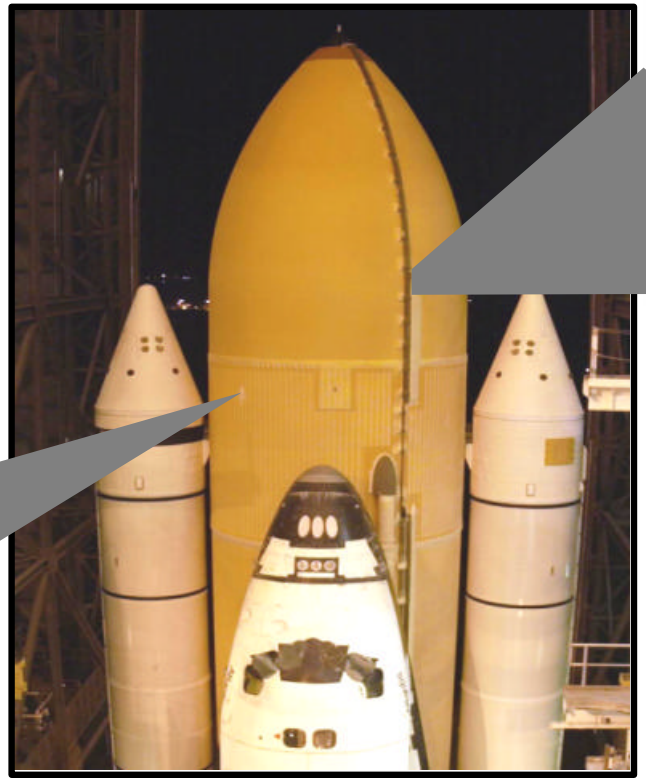
- Camera System Review
  - MSFC Technical Exchange Forum was convened to review the camera design
    - Identified no safety of flight issues
    - Recommended additional testing to reduce risk of functional failure

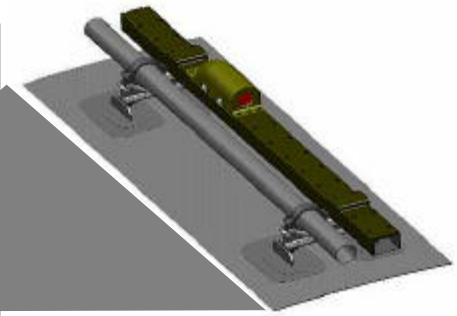
ET Camera Hardware Design



Electronics Package

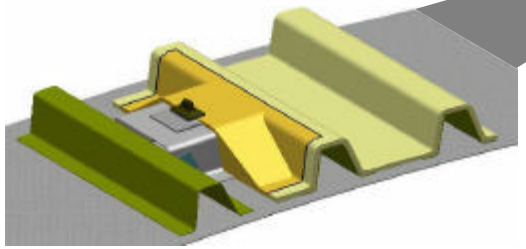
- Mounted Inside Intertank on SRB Crossbeam -Y Side (Close Proximity to I/T Door)





Two S-band Antennas

- Installed at Sta. 903 in Locations 180° Apart

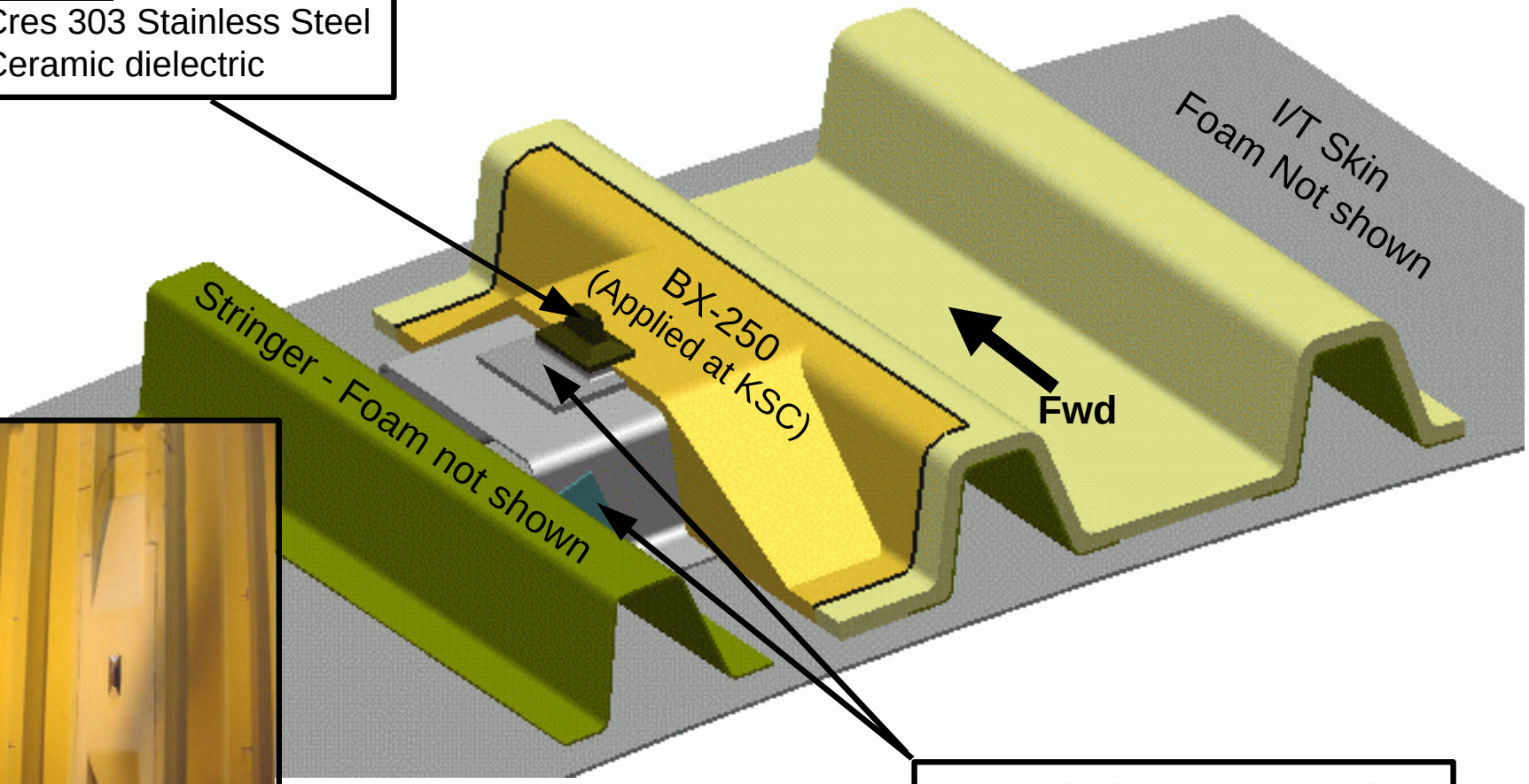


Camera and Fairing

- Installed on Modified LO2 Cable Tray Cover at Sta. 718

Camera Antenna Design

Antenna
- Cres 303 Stainless Steel
- Ceramic dielectric

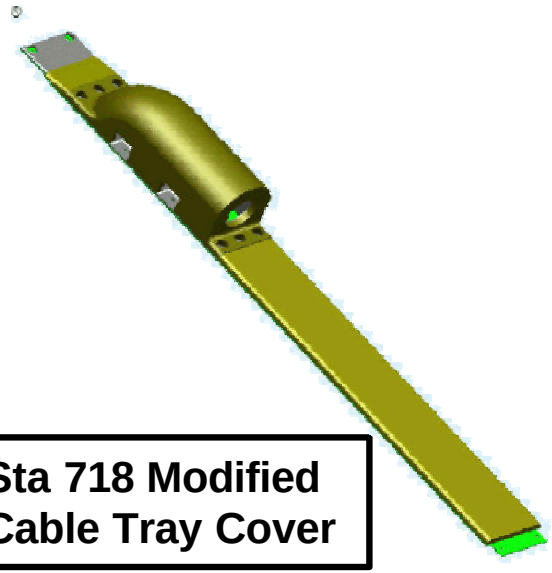


ET-115 Antenna Installation

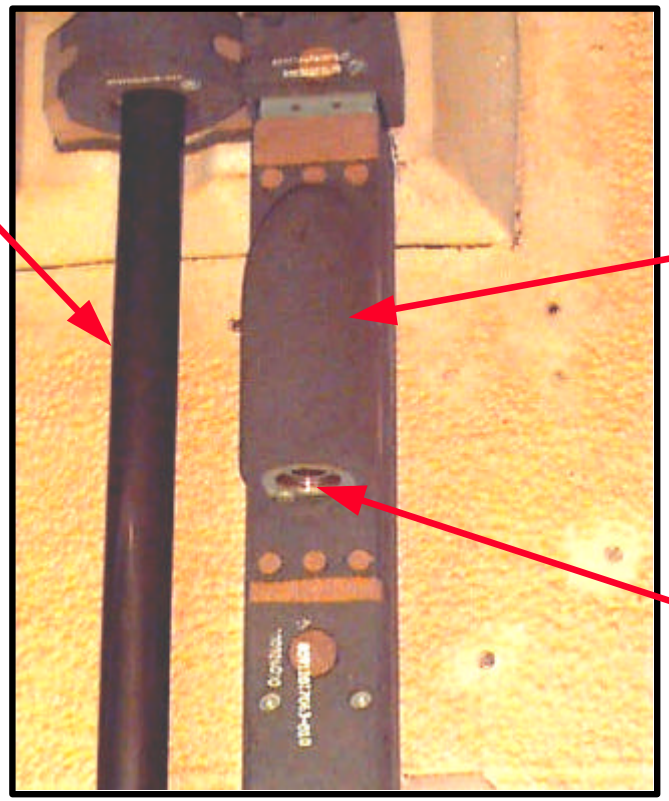
Ground Plane, Spacer Plate & Attach Clips (4 Req'd)

Camera Antenna Design

Existing GO2 Pressurization Line



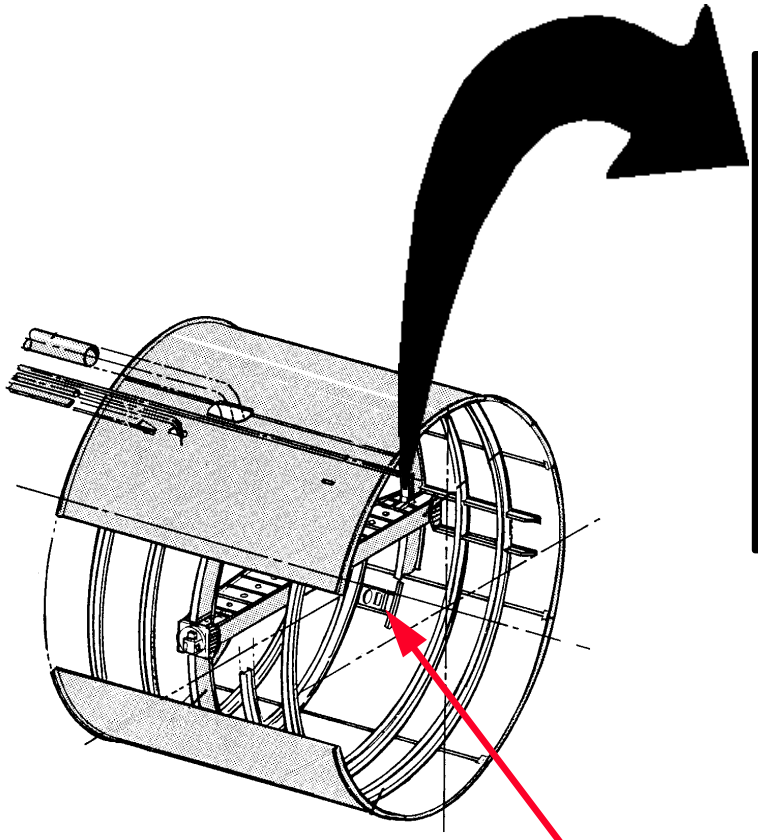
Sta 718 Modified Cable Tray Cover



Fairing Assembly
- 1/4" quartz window
- Al 2219 with SLA for thermal protection

Camera
- Flown on Delta, Atlas & Titan

Electronics Package Design



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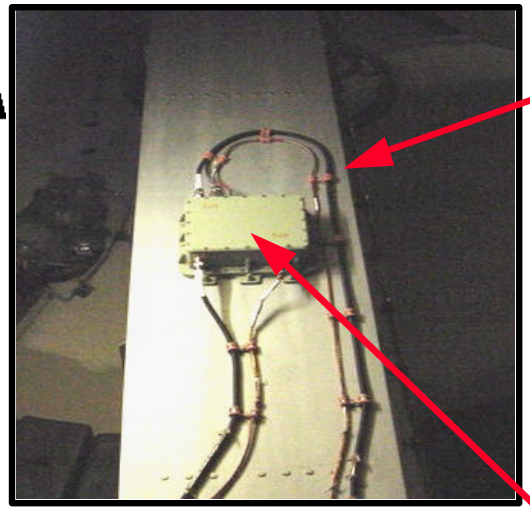


Cabling
- Video coaxial cable and connectors
- Antenna cable
- Power cable

Electronics Package
- **Electronics Box and Attach Hardware**
- **Electronic Components**
  - Batteries
  - 10 watt Transmitter
  - G-Switch, Power Splitter, PC Board

GUCP Connection
- For battery charging, on/off capability, and battery health monitoring

Flight Hardware Certification Summary

- **Camera System Hardware Qualification Testing**
  - **System Electromagnetic Interference (EMI) – *SL-E-0002 requirements verified***
    - **Compatibility testing performed at ESTL (JSC) and Goddard – *No Issues***
  - **Fairing, Antenna, and Electronics Box vibration**
  - **RF and corona testing**
  - **Electronics Box proof test**
  - **Electronics Box explosive environments test**

- **Camera System Hardware Acceptance**
  - **Functional verification of components**
  - **Transmitter burn-in**
  - **Electronics Box proto-flight vibration, thermal cycling, and burn-in**
  - **Antenna pattern verification**
  - **Camera proto-flight vibration and burn-in**

Flight Hardware Certification Summary

- **Analysis of ET Camera System Complete**
  - **Standard structural and thermal analysis was performed for system components and no issues with design were identified**
    - **Environments coordinated with Level II**
    - **Factor of safety greater than 2.0 was required for all new hardware**
  - **Analysis performed to assess safety of camera system**
    - **Intertank hazardous gas analysis with battery leakage performed - No Issue**
    - **FMEA analysis identified two new Aerodynamically Sensitive Items (ASI) as Criticality 1 for becoming debris (existing failure mode)**
      - **Camera Fairing**
      - **Antenna**
    - **Retention rationale for new Criticality 1 ASI was documented in CIL and inspections added to CIL Implementation Drawing**
    - **Flight Camera System Safety Analysis Report was generated and reviewed**

ET Camera System Certification is Complete

Status

- **ET-Mounted Shuttle Observation Camera System has been verified**
- **Use of Commercial Off the Shelf (COTS) hardware carries additional risk of functional failure**
  - **Risk mitigated to maximum extent feasible**
  - **System does not functionally interface with any critical flight system**
- **Two new Criticality 1 Aerodynamically Sensitive Items have been added**
  - **Retention rationale has been documented and accepted**
- **Testing and Analysis shows system meets all Level II requirements**

ET-Mounted Shuttle Observation Camera System is Ready for Flight

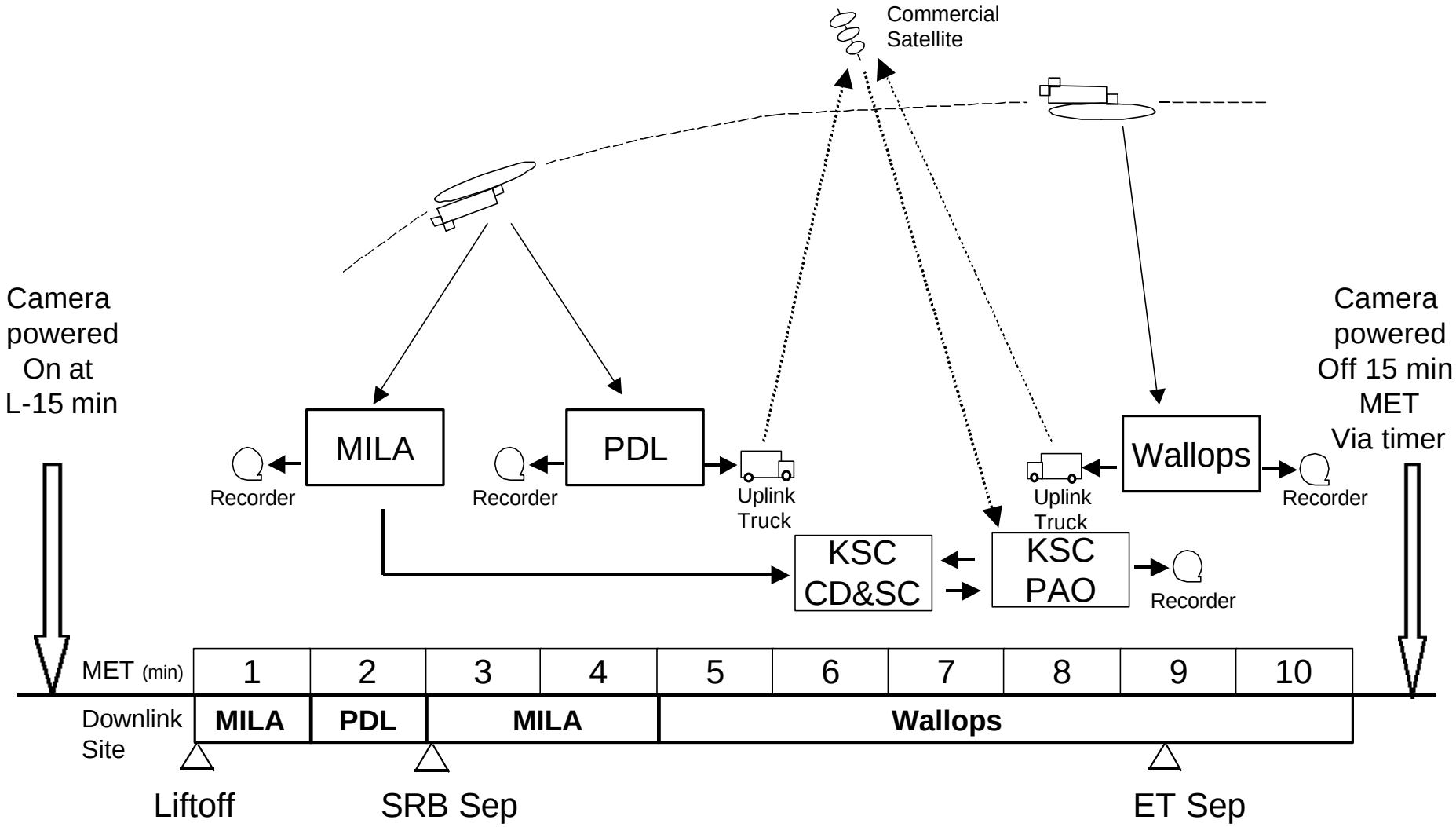
Ground Systems Overview

- Ground systems provide 3 functions for camera system
  - Camera On/Off Command
  - Camera System Battery Charge
  - Camera Battery health monitoring (voltage & current)
- Interface with camera system is accomplished through the ET GUCP utilizing spare circuits and wires
- Commands issued and health monitoring of camera system is accomplished utilizing a laptop PC
- Procedures for testing and operating camera system were developed
- Both Pad A & Pad B were modified and tested to accommodate camera and are ready to support

Network Support for ET TV

- NASA sites MILA, PDL, and Wallops (WPS) will receive, record, and remote ET TV during launch to KSC PAO for release on NASA Select
  - MILA provides TV via existing hardline interface to KSC
  - PDL & WPS simultaneously send TV via TV trucks and satellite links rented for launch day
- Predicted launch support coverage analysis completed
- Site modifications have been completed
- Compatibility testing of the ET TV transmitter and camera with NASA sites is complete
  - Included hardware testing at MILA
- End to End Test with MILA, PDL, WPS and KSC is complete
  - Demonstrated satellite links and site interfaces with KSC PAO
- Forward plan is RF signal presence and quality checks with MILA during flow
  - Pad Testing (L-3 weeks); TCDT checks (L-2 weeks); launch count signal presence

Camera Operational Links



READY TO FLY!

- All ET Camera systems design and operational requirements have been verified
- Final integrated system and network test pending TCDT
- Shuttle ET Camera is ready to fly

STS-112 Flight Readiness Statement

THIS CERTIFIES THAT ALL MISSION REQUIREMENTS HAVE BEEN MET AND SPACE SHUTTLE INTEGRATION IS READY FOR FLIGHT, PENDING COMPLETION OF THE DEFINED OPEN WORK AND NOTED EXCEPTION

/s/ original on file *9/11/02*

L. D. AUSTIN, JR., MANAGER
SPACE SHUTTLE SYSTEMS INTEGRATION

/s/ original on file *9/11/02*

M. A. BREKKE, MANAGER
SPACE SHUTTLE CUSTOMER AND FLIGHT INTEGRATION

/s/ original on file *9/11/02*

F. R. HINSON, Acting ASSOC. PROG. MGR
PROGRAM INTEGRATION
UNITED SPACE ALLIANCE

/s/ original on file *9/13/02*

A. M. LARSEN, MANAGER
PAYLOAD SAFETY

/s/ original on file *9/11/02*

R. N. RICHARDS, PROGRAM DIRECTOR
SHUTTLE & SPACE STATION INTEGRATION
BOEING HUMAN SPACE FLIGHT & EXPLORATION

/s/ original on file *9/13/02*

R. L. SEGERT, MANAGER
SPACE SHUTTLE KSC INTEGRATION

/s/ original on file *9/11/02*

R. S. GALVEZ, FLIGHT MANAGER
SPACE SHUTTLE PROGRAM INTEGRATION

STS-112 Flight Readiness Review

Backup Charts

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STS-112 Orbital Debris Status

- **Orbital Debris / Micrometeroid Risk is Acceptable**

Criteria	Risk	Guideline
Critical Penetration	1 in 259	1 in 200
Radiator Tube Penetration	1 in 298	1 in 61
Window Replacement	73%	N/A

Approved Launch Commit Criteria for STS-112

- **LCN 1064R03 Control Bus Drops During ET Cryo Tanking**
  - **Trouble-shooting for RPC OFF indications which requires control bus drops was previously not allowed after the start of ET cyro tanking**
  - **Refined and SAIL tested procedures now make it possible to safely drop a control bus up to T-20 minutes as long as the vehicle is in a quiescent state (restrictions in place in S0007 VL5 and OMRS S00GEN.780)**
  - **SSIDs affected: GNC-08, GNC-09, GNC-32, GNC-39, GNC-57, EPDC-08**

- **LCN 1085R02 Preplanned Procedures for Instrumentation Failure**
  - **Adds preplanned procedures needed to determine if acceptable instrumentation failure has occurred, and state the Go/No Go criteria, when requirements allow for it**
  - **SSIDs affected: SSME-01, HYD-05, GNC-22, GNC-25, GNC-26, GNC-28**

Approved Launch Commit Criteria for STS-112

- **LCN 1094R03 GN2 Supply Valve Closed Indicator Troubleshooting Update**
  - **ECL-03 currently contains a preplanned contingency procedure (PCP) which could trap pressure between a N2 System Supply Valve and a N2 System Reg Inlet Valve, possibly resulting in an incorrect conclusion that the GN2 Supply Valve is open (a Go condition) when in reality it is actually closed (A No Go condition)**
  - **This change updates that PCP to resolve the above problem and implements technical clarifications/updates and editorial cleanup in other areas of the SSID**

- **LCN 1105R01 STS-112 Minimum Equipment List Mission Specific Exceptions**
  - **Standard MEL update for mission specific hardware requirements**

Approved Launch Commit Criteria for STS-112

- **LCN 1106R01 Deletion of Mandatory Redundancy for LPS FEPs from T-6 Hours**
  - **Update of LPS Section to clarify FEP and LDB redundancy requirements**
  - **Front End Processor (FEP) redundancy is considered to be highly desirable, but not mandatory to continue to a successful launch**
  - **Launch Data Bus (LDB) redundancy provides a degree of insurance against a second failure prior to Stable Replenish which may compromise the ability to safely secure**

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USA PROGRAM INTEGRATION FLIGHT PREPARATION PROCESS

Presenter:	Bob White
Organization/Date:	Program Integ/09-17-2002

- **All the Systems and Cargo Integration flight preparation activities have been completed except for planned open work – no issues identified**

- **Completed tasks include:**
  - Verification of compliance with generically certified requirements
  - Mission specific analyses
  - Documentation of vehicle and cargo requirements
  - Reconfiguration / installation of Payload Integration hardware
  - Payload bay clearance assessment

- **Assessments completed to resolve mission specific issues**
  - BSM RTV debris trajectory analysis – To be presented by SRB Project
  - Lift-off loads exceedance on MPM – To be presented by Orbiter Project

Program Integration Is Ready to Support Flight

STS-112 Integration Transition Status
CoFR Flight Product Status

Cargo Integration

STS-112	STS-113	STS-107	STS-114	STS-115	STS-116	STS-117	STS-118

System Integration

STS-112	STS-113	STS-107	STS-114

GREEN: Primary and backup personnel in place to produce required products, or required products have been produced

YELLOW: Single string exists for required products

RED: Neither primary nor backup personnel in place for required products

- Yellow rating due to single string MPS post flight processing
  - STS-113, 107
- Yellow rating due to single string post-flight data acquisition / processing
  - STS-113, 107

Former Yellow rating due to single string MPS LOX pressurization analysis is now Green